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EFFECT OF PLANT GROWTH REGULATORS ON FLOWER QUALITY, YIELD AND POST HARVEST SHELFLIFE OF CHINA ASTER (*CALLISTEPHUS CHINENSIS* L. NEES.) *CV*. LOCAL

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ABSTRACT

An experiment was undertaken to study the "Effect of plant growth regulators on flower quality, yield and post harvest shelflife of China aster (Callistephus chinensis L. Nees). The growth regulators used were gibberellic acid (GA_3 @ 100,150 and 200 ppm), salicylic acid (SA @ 50, 100 and 150 ppm), brassinolide (BA @ 0.5, 1.0 and 1.5 ppm) and triacontanol (TR @ 1.0, 2.0 and 3.0 ppm). The growth regulators were applied as foliar sprays at two stages viz., 45 days and 60 days after transplanting and water spray as control. Application of GA_3 at 150 ppm promoted the various growth and yield parameters. Spraying of GA_3 at 150 ppm promoted early bud initiation (65.45 days) and days taken for full flowering (88.20 days after transplanting), days taken for first flowering (72.47days), days taken for full flowering (88.20 days) and flower stalk length (37.95 cm), flower diameter (6.91 cm), number of flowers plant^{-1} (52.20), individual flower weight (3.92 g), hundred flower weight (399.47 g), flower yield plant $^{-1}$ (210.03 g), flower yield plot^{-1} (6.44 kg) and estimated yield ha^{-1}(16.10 tonnes) were significantly increased by the application of GA_3 at 150 ppm. Among the post harvest treatments, flowers maintained in the non ventilated, 200 gauge polyethylene bags with pre harvest sprays of 150 ppm GA_3 enhanced the shelf life of flowers (8.68 days) followed by salicylic acid at 100 ppm (8.55 days) and minimum shelf life was recorded in control (3 days in open). Foliar application of GA 3 at 150 ppm would be effective for improved yield and quality of China aster.

KEYWORDS: Asteraceae, Annual, China Aster, Variety & Growth Regulators

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Original Article

INTRODUCTION

Globally, more than 140 countries are involved in cultivation of floricultural crops. In India about 232.74 thousand hectares area was under cultivation in floriculture during 2012-13. In India, production of flowers were 1.72 million tonnes of loose flowers and 76.73 million stems cut flowers in 2012-13. The country has exported 22,485.21 million tonnes of floriculture products to the world for the worth of Rs. 455.90 crores during 2013-14.The major export destinations are United States, Netherlands, Germany, United Kingdom, United Arab Emirates, Japan and Canada (APEDA 2014).

China aster (*Callistephus chinensis* L. Nees.) is an important annual flower crop belonging to the family Asteraceae. It is native to China and it has spread to Europe and other tropical countries during the year 1731 (Desai, 1962). The genus *Callistephus* is derived from two Greek words *Kalistos* meaning "most beautiful" and

stephus "a crown" referring to the flower head. The growth and yield of the plant is mainly influenced by two principle factors *viz.*, genetic and management factors. In recent years, scientists have paid due attention to the idea of regulating plant growth by means of growth regulators as third most important factor in improving growth, yield and flower quality in various ways. These substances modify the plant system, which ultimately affects plant growth and development (Aklade, 2010). Synthetic growth regulating chemicals are becoming extremely important and valuable in the commercial floriculture for manipulating the growth and flowering of many commercial flower crops and ornamental plants. In order to find out the most appropriate dosage of plant growth substances for different physiological functions of flower crops. With these views the objectives of the study is follows,

- To study the effect of plant growth regulators on flower yield and quality of China aster.
- To study the effect plant of growth regulators on post harvest shelf life of China aster.

MATERIALS AND METHODS

The present investigation was conducted during October, 2014 at Department of Floriculture & Landscaping, Tamil Nadu Agricultural University, with the objective to study the effect of plant growth regulators on growth and flower yield of china aster. The experiment was laid out in a Randomized Block Design (RBD) with three replications. The treatments in each replication were allotted randomly. This experiment having four growth regulators with twelve different treatments and water spray used as control. Ten raised nursery beds of size 2.0 m x 2.0 m were first prepared and drenched with Captan (0.01%). Seeds of different varieties were also treated with Captan (2 g / kg seeds) for five minutes and then sown in lines. The nursery beds were watered daily twice for first 10 days and daily once for the remaining period. Hand weeding was done thrice when the seedlings were 25 days, 35 days and 45 days old. The seedlings were ready for transplanting at 45 days after sowing. The details of the treatments as follows.

Table 1: Treatments Details

Treatments	Particulars
T_1	GA_3 150 ppm
T_2	GA_3 200 ppm
T_3	GA_3 250 ppm
T_4	Salicylic Acid 50 ppm
T_5	Salicylic Acid 100 ppm
T_6	Salicylic Acid 150 ppm
T_7	Brassinolide 0.5 ppm
T_8	Brassinolide 1.0 ppm
T_9	Brassinolide 1.5 ppm
T_{10}	Triacontanol 1.0 ppm
T_{11}	Triacontanol 2.0 ppm
T_{12}	Triacontanol 3.0 ppm
T_{13}	Control (Water spray)

The land was brought to a fine tilth by repeated ploughing and harrowing. Forty five days old healthy and uniformly grown seedlings were used for transplanting with a spacing of 30 cm x 30 cm at the rate of one seedling per hill. Fertilizer application, weeding, plant protection etc. were carried out as per package of practices released by IIHR. The observations were recorded on number of days taken for bud initiation, number of days taken for first flowering, number of days taken for full flowering, flower stalk length, flower diameter, number of flowers plants^{-1}, individual flower weight plant $^{-1}$, hundred flowers weight, yield of flowers plant^{-}1, flower yield plot^{-1}, estimated flower yield ha^{-1} and

postharvest shelf life of flowers.

RESULTS AND DISCUSSIONS

Effect of Plant Growth Regulators on Flower Quality, Yield and Postharvest Shelf Life of China Aster

Significant differences were observed for number of days taken to bud initiation. The treatment GA_3 at 150 ppm recorded earliest bud initiation among all the treatments (65.45) followed by the treatment SA 100 ppm (66.78) and the control took 79.92 days for bud initiation. The number of days taken to full flowering was significantly influenced by spray of different growth regulators. The least duration of 88.20 days for full flowering was observed with the GA_3 at 150 ppm treatment, followed by SA 100 ppm. The control takes 100.43 days for full flowering. Improvement in floral characters may be due to an increased efficiency of GA_3 treated plants. GA_3 is a component of florigen which is required for formation of flowers in plant system. The enhanced vegetative parameters by GA_3 application, might had a positive bearing on earlier flowering and this is in conformity with the results of Devadanam *et al.* (2007) and Sandeep Kumar *et al.* (2010) in tuberose. (Table 2)

The treatment GA_3 at 150 ppm flowered for a longest period of 58.22 days, which was followed by SA 100 ppm (57.60 days). The lowest flowering duration was observed in control (41.23 days). Flowering duration has a positive influence by the GA_3 application. Longest duration of flowering recorded with GA_3 (150 ppm) might be due to an increased production of flowering shoots (Garrod and Harris, 1974) in carnation. Both long photoperiod and gibberellic acid had an additive effect on flowering duration due to their early induction of flowering as reported by Ramesh Kumar *et al.* (2003) in carnation. (Table 2)

The longer flower stalk length was observed in GA_3 and SA treatments which were highly significant over all other treatments. GA_3 at 150 ppm produced the longest stalks (37.95 cm) followed by SA at 100 ppm (36.87 cm). The shortest flower stalk length was noticed in control with 27.10 days. The spray of different growth regulators produced significant variations in flower diameter. The higher flower diameter was recorded with GA_3 at 150 ppm (6.91 cm) followed by SA at 100 ppm (6.80 cm).The smaller flower diameter was observed with control (4.11 cm). The increase in the length of flower stalk might be due to an increase in the length of the branch. Increase in stalk length might be due to the translocation of photosynthates to the flower as a consequence of intensification of the sink and also due increased cell division and elongation. This may be due to the maximum stalk length and stems were straight and thicker having high accumulation of carbohydrates. Similar results were obtained by Aklade *et al.* (2010) and Devadanam *et al.* (2007) in tuberose. (Table 2)

GA_3 treatments recorded significantly higher number of flowers plant $^{-1}$ than other treatments. GA_3 at 150 ppm exhibited the highest number of flowers plant $^{-1}$ (52.20) followed by SA at 100 ppm (51.35).The control registered the lowest number of flowers (47.13).The fresh weight of individual flower varied significantly due to the application of different growth regulators. However, the maximum fresh weight of individual flower was recorded with GA_3 at 150 ppm (3.92 g) and followed by SA at 100 ppm (3.88 g). The minimum was recorded with control 2.91 g. The weight of 100 flowers differed significantly among the treatments. The highest 100 flowers weight was observed with GA_3 at 150 ppm (399.47 g) followed by SA 100 ppm (397.54 g) The lowest 100 flowers weight was observed with control (214.45 g). Flower diameter and weight of flowers are the characters which significantly contribute the yield. The flower diameter differed significantly due to growth regulator spray. However GA_3 150 ppm recorded maximum flower diameter. Increase in flower diameter might be due to active cell elongation in the flower, which increased the flower diameter and GA_3 might

be due to increased strength of the actively growing parts. These findings are in line with those of Prabhat Kumar *et al*. (2003) in China aster, Samruban and Karuppiah, (2007) in French marigold and Sujatha *et al*. (2002) in gerbera. (Table 3)

The different growth substances treatments were exhibited highly significant effect on yield of flowers plant $^{-1}$. The flower yield plant^{-1} was found to decline with increase in the concentrations of the chemicals. The higher yield of plant $^{-1}$ (210.03 g) was recorded with application of GA_3 at 150 ppm followed SA at 100 ppm (204.72 g). The lowest yield plant^{-1} was recorded with the control (155.20 g). Among the treatments, the highest flower yield plot $^{-1}$ (6.44 kg) was recorded with application of GA_3 at 150 ppm followed SA at 100 ppm (6.30 kg). The lowest yield plot^{-1} was recorded with the control (4.77 kg). The highest estimated yield ha^{-1} (16.10 tonnes) was recorded with application of GA_3 at 150 ppm followed by SA at 100 ppm (15.75 tonnes). The lowest estimated yield ha^{-1} were recorded with the control (11.94 tonnes). Maximum yield plant^{-1} was also recorded by application of GA_3 (150 ppm). The increase in yield attributes might be due to the fact that gibberellic acid stimulated vegetative growth and induced changes in vegetative morphology. It could be ascribed to accelerate the number of laterals plant^{-1} and increased flower production. The results of the present study are in conformity with those of Dutta (1997), Padmapriya and Chezhiyan (2000) and Singhrot *et al.* (2003) in chrysanthemum. (Table 3)

The results and discussion of the experiments conducted to assess the influence of open conditions and polyethylene packaging with or without ventilation on the shelf life of China aster flowers subjected to treatment with the growth regulators are presented here. The treatment GA_3 at 150 ppm (4.40 days) and SA at 100 ppm (4.35 days) exhibited significantly higher shelf life under open condition. The shortest shelf life was recorded in control. The 200 gauge polyethylene packaging with 0.5 per cent ventilation recorded longer shelf life of GA_3 at 150 ppm (6.82 days) followed by SA at 100 ppm (6.75 days. In 200 gauge without ventilation the treatment GA_3 at 150 ppm registered longer shelf life of 8.68 days followed by SA at 100 ppm of 8.55 days. The control recorded with 8.10 days. The maximum extension of shelf life which might be due to the overall modified effect on the vegetative and reproductive growth of the plant. It was noticed that polyethylene (PE) bags of higher thickness of 200 gauge increased the freshness of China aster flowers to some extent. The increase in the thickness of PE bags is directly correlated with a reduction in the permeability of the bag to moisture and air, thereby reducing the physiological loss in weight (PLW). This might be due to the reduction in the loss of moisture as well as respiration resulting in reduced O_2 and increased Co_2 levels. Co_2 was found to antagonize ethylene action, decreases respiration and delay senescence observed by Halevy and Mayak (1981) is in corroboration with the results of the present investigation. (Table 4)

Table 2: Effect of Plant Growth Regulators on Flowering Parameters of China Aster

Treatments	Days Taken for Bud Initiation	Days Taken for First Flowering	Days Taken for Full Flowering	Flower Stalk Length (cm)	Flower Diameter (cm)
T_1 - GA_3 150 ppm	65.45	72.47	88.20	37.95	6.91
T_2- GA_3 200 ppm	70.39	77.61	93.61	31.00	5.60
T_3- GA_3 250 ppm	74.37	81.62	92.24	29.93	5.77
T_4- Salicylic Acid 50 ppm	73.05	76.91	93.34	29.20	5.68
T_5- Salicylic Acid 100 ppm	66.78	74.77	88.53	36.87	6.80
T_6- Salicylic Acid 150 ppm	67.94	88.48	98.97	31.73	5.17
T_7- Brassinolide 0.5 ppm	73.90	69.95	94.38	32.40	4.67
T_8- Brassinolide 1.0 ppm	74.06	75.28	89.57	30.60	4.83
T_9- Brassinolide 1.5 ppm	74.22	77.74	89.60	28.73	5.13
T_{10} - Triacontanol 1.0 ppm	76.81	75.68	89.41	29.53	5.37

Table 2: Contd.,					
T_{11} -Triacontanol 2.0 ppm	74.48	75.89	90.18	28.07	5.13
T_{12} - Triacontanol 3.0 ppm	70.97	76.12	91.54	28.98	5.37
T_{13}- Control (Water spray)	79.92	76.37	100.43	27.10	4.11
SE (d)	**1.0665**	**1.4025**	**1.7273**	**1.7870**	**0.3737**
CD at 5%	**2.2011****	**2.8946****	**3.5649****	**3.6883****	**0.7713****

Table 3: Effect of Plant Growth Regulators on Flower Yield Parameters of China Aster

Treatments	Number of Flowers Plant $^{-1}$	Individual Flower Weight Plant^{-1} (g)	Hundred Flowers Weight (g)	Flower Yield Plant^{-1} (g)	Flower Yield Plot^{-1} (Kg)	Estimated Flower Yield ha^{-1} (Tonnes)
T_1 - GA_3 150 ppm	52.20	3.92	399.47	210.03	6.44	16.10
T_2- GA_3 200 ppm	51.04	3.75	387.76	198.40	5.88	14.71
T_3- GA_3 250 ppm	51.05	3.20	390.17	170.32	5.23	13.09
T_4- Salicylic Acid 50 ppm	50.12	3.40	386.64	173.80	5.34	13.37
T_5- Salicylic Acid 100 ppm	51.35	3.88	397.54	204.72	6.30	15.75
T_6- Salicylic Acid 150 ppm	48.35	3.24	320.18	160.39	4.93	12.34
T_7- Brassinolide 0.5 ppm	48.40	3.30	318.51	161.20	4.96	12.41
T_8- Brassinolide 1.0 ppm	49.07	3.12	347.50	159.90	4.84	12.26
T_9- Brassinolide 1.5 ppm	50.29	3.18	301.55	160.20	4.93	12.33
T_{10} -Triacontanol 1.0 ppm	47.19	3.15	327.14	157.90	4.86	12.15
T_{11} -Triacontanol 2.0 ppm	48.98	3.07	315.07	156.40	4.81	12.04
T_{12} - Triacontanol 3.0 ppm	50.09	3.42	311.60	175.30	5.39	13.49
T_{13}- Control (Water spray)	47.13	2.91	214.45	155.20	4.77	11.94
SE (d)	**0.5782**	**0.0764**	**6.4481**	**1.3852**	**0.3605**	**0.1423**
CD at 5%	**1.1933****	**0.1577****	**13.3015****	**2.8590****	**0.7456****	**0.2506****

Table 4: Effect of Plant Growth Regulators on Shelf Life of Flowers (Days)

Treatments	Shelf Life of Flowers (Days)				
	Open	100 Gauge Polyethylene Packaging with		200 Gauge Polyethylene packaging with	
		0.5 % Ventilation	No Ventilation	0.5 % Ventilation	No Ventilation
T_1 - GA_3 150 ppm	4.40	6.44	6.79	6.82	8.68
T_2- GA_3 200 ppm	4.19	5.98	5.89	6.26	8.24
T_3- GA_3 250 ppm	4.15	5.93	5.41	6.24	8.18
T_4- Salicylic Acid 50 ppm	3.49	4.57	5.74	6.61	8.13
T_5- Salicylic Acid 100 ppm	4.35	6.19	6.54	6.75	8.55
T_6- Salicylic Acid 150 ppm	3.51	5.43	5.69	6.14	8.23
T_7- Brassinolide 0.5 ppm	3.97	5.34	5.36	6.00	8.30
T_8- Brassinolide 1.0 ppm	3.85	5.90	6.23	6.37	8.20
T_9- Brassinolide 1.5 ppm	3.98	6.13	5.92	6.19	8.20
T_{10} -Triacontanol 1.0 ppm	3.57	5.92	6.00	6.24	8.16
T_{11} -Triacontanol 2.0 ppm	4.24	5.53	5.86	6.24	8.29
T_{12} - Triacontanol 3.0 ppm	3.68	5.25	5.24	6.34	8.25
T_{13}- Control (Water spray)	3.00	4.96	4.95	5.12	8.10
SE (d)	**0.0502**	**0.0701**	**0.1056**	**0.1051**	**0.1199**
CD at 5%	**0.1035***	**0.1447***	**0.2180***	**0.2169***	**0.2476***

CONCLUSIONS

Among all the treatments, the treatment GA_3 150 ppm performed well and positively influenced the yield, quality and post harvest shelf life of China aster.

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